REMARKS

The specification has been amended as set forth above, in order to correct a clerical error. This is not an amendment related to patentability. Claims 1 and 3 remain for consideration in this application.

Furthermore, attached hereto is a correct copy of claim 1. Claim 1 has been amended on August 29, 2000, February 22, 2001 and February 19, 2002. Specifically, the version of claim 1 presented in the amendment dated February 19, 2002 was incorrect. That version listed (in the first paragraph) the liquid crystal device having a "twisted angle of 190° degrees to 260°degrees". In fact, this language did not follow the change to claim 1 in the amendment of February 22, 2001, in which the twisted angle range was changed to "greater than 180° and less than or equal to 260°". Accordingly, the attachment hereto is a correct recitation of claim 1 as finally amended in the response of February 19, 2002. Accordingly, the attached copy of claim 1 adds no further amendment to claim 1, but simply provides the correct recitation of claim 1 as last amended.

Claims 1 and 3 are rejected under 35 U.S.C. §103(a) as being unpatentable over Amstutz (U.S.P. 4,634,229) in view of Matsunaga (U.S.P. 5,548,423).

The instant invention, as set forth in claims 1 and 3 is directed to a liquid crystal shutter using an STN liquid crystal device in which response speed is high, the display is less colored, and contrast is high. As set forth in claim 1, the absorption axes of a pair of polarizing plates are orthogonal to each other so that the transmittance in a closed state is low. Thus, the lowering of the contrast can be prevented. In addition, the instant invention is able to lower the coloring of transmitted light by setting a range of angle in directions of the absorption axes of the respective polarizing plates and

intermediate liquid crystal molecules of the liquid crystal device to ± 40° to ± 50°.

Furthermore, in the state where no voltage is applied, white display is performed by the birefringence of the liquid crystal, a voltage of 10 to 20 volts is applied to nullify the birefringence, and liquid crystal molecules are raised substantially perpendicular to the substrate in order to perform black display. Accordingly, in an opened state (white display) of the liquid crystal shutter, high transmittance by the birefringence peculiar to an STN liquid crystal device can be realized. On the other hand, in a closed state (black display) liquid crystal molecules are raised substantially perpendicular to the substrate and the birefringence is almost nullified, so that it becomes possible to provide a liquid crystal shutter with high contrast, a response time of several ms, and a high speed response time which ten times faster than a conventional STN liquid crystal shutter. In **Amstutz**, col. 5, lines 17-25 disclose that the "vibration direction of the polarizers 10 and 11 are rotated from the orientation direction of the orientation layers 8 and 9, represented by the dashed line in the polarizer planes by the angles β and γ ."

In fact, β and γ simply represent a deviated angle of an absorption axes of a polarizing plate and a direction of alignment of liquid crystal in the present invention. Thus, it should be clear that the value of β + γ is not simply a crossed angle of absorption axes of a pair of polarizing plates. Attached hereto as Exhibit 1 is an analysis provided by the inventor in the instant application. This analysis compares examples of the instant invention (as set forth in claim 1) and an example in accordance with **Amstutz**. It is clear from the analysis of the inventor, a twisted angle of a liquid crystal device in the present invention is greater than 180° degrees and less than or equal to 260°. The absorption axes of a pair of polarizing plates are orthogonal to each other in the above range in

the twisted angle, which is only possible in the liquid crystal shutter of the invention of claim 1, but not in any of the examples of **Amstutz**.

Additionally, the invention of Fig. 1 has the distinction of "setting a range of angle of directions of the absorption axes of the respective polarizing plates and intermediate liquid crystal molecules of a liquid crystal device within ± 40° to ± 50°". This feature also is not disclosed in **Amstutz**.

Regarding **Matsunaga**, Mr. Matsunaga is also one of the inventors of the instant invention, which is an improvement over the disclosure of the **Matsunaga** reference. In addition to the distinction of applying a high voltage of 10 to 20 volts to a liquid crystal device, the invention of claim 1 is distinguished from any combination of **Amstutz** and **Matsunaga** in that a liquid crystal shutter with a rapid response, less coloring, and a high contrast can be obtained by all the conditions of an alignment angle of absorption axes of a pair of polarizing plates being orthogonal to each other and a range of angled directions of intermediate liquid crystal molecules and absorption axes of respective polarizing plates. Thus, in view of the remarks above, it is submitted that even a combination of **Amstutz** and **Matsunaga** do not suggest the invention set forth in claim 1, for the reasons set forth above.

In view of the amendment to the specification and the remarks above regarding the prior art, applicants submit that the rejection has been overcome. Accordingly, it is respectfully requested that the Examiner withdraw the rejection and allow present claims 1 and 3.

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attached page is captioned **"Version With Markings to Show Changes Made."**

In the event that this paper is not timely filed, Applicants respectfully petition for an appropriate extension of time. Please charge any fees for such an extension of time and any other fees which may be due with respect to this paper, to Deposit Account No. 01-2340.

Respectfully submitted,

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By: **Yasushi KANEKO et al.** Serial No. **08/981,654**

Version With Markings to Show Changes Made

IN THE SPECIFICATION:

Please amend the specification as follows:

Please replace the paragraph beginning at page 15, line 9, with the following rewritten paragraph:

Fig. 4 shows arrangement angles of the lower polarizing plate 8 and the transmittance of the liquid crystal shutter, obtained when the lower polarizing plate 8 is rotated counterclockwise from the direction 12 in which the intermediate liquid crystal molecules are orientated, with the intersection angle fixed at 90° between the absorption axis 13 of the lower polarizing plate 8 and the absorption [angle] axis 14 of the upper polarizing plate 9 in a 240° twisted liquid crystal device having a value of Δ nd equal to 800nm.

Exhibit 1

Present Invention

The present invention is directed to a liquid crystal shutter using STN liquid crystal. Thus, no birefringence is shown when an STN having a twisted angle (ϕ) of greater than 180° and less than or equal to 260°, a pair of polarizing plates having respective absorption axes which are orthogonal to each other, and the absorption axes of the polarizing plates are angled within a range of ±40° to ±50° relative to a direction in which intermediate liquid crystal molecules are oriented, and voltage of 10 to 20V is applied.

Amstutz

Amstutz discloses a basic patent of an STN liquid crystal display device by Brown Boveri & Co., Ltd.

A table below shows a comparison of examples between the present invention and Reference 1.

	ϕ	Ψ	P1	P2	γ	β	$\gamma+\beta$
Example of present invention	240	90	-45	+45	105/15	75/-15	0
Example of Amstutz	270	90	0	90	45	45	90

ϕ: twisted angle

Ψ: crossed absorption axes angle of a pair of polarizing plates

P1: angle of intermediate liquid crystal molecules and an absorption axis of upper polarizing plate

P2: angle of intermediate liquid crystal molecules and an absorption axis of lower polarizing plate

β: upper liquid crystal molecules and absorption axis of upper polarizing plate

γ: lower liquid crystal molecules and absorption axis of lower polarizing plate

Amstutz discloses a basic structure of an STN liquid crystal display device which is disclosed in the Description of the present application as a prior art (b). See page 4, line 16 to page 6, line13, and page 7, line 8 to 18 in the Description.

In Amstutz, $\beta + \gamma = 90°$ or $0°$, $20° \leq \beta \leq 70°, 20° \leq \gamma \leq 70°$, and a crossed absorption axes angle of a pair of polarizing plates should be led by $\Psi = |\gamma - \beta| + \phi$

Crossed absorption axes angle Ψ becomes 90° when ϕ is 270°, β is 45° and γ is 45°, but P1 becomes 0° and P2 becomes 90° in the Example of Amstutz. In this Example, twisted angle ϕ is greater than 260° and above-mentioned P1, P2 are not within a range of ± 40° to ± 50.

Amstutz does not disclose or teach that a crossed absorption axes angle Ψ becomes 90° and P1, P2 becomes within a range of ± 40° to ±50 when a twisted angle ϕ is greater than 180° and less than or equal to 260°.

Only the present invention discloses that when a twisted angle ϕ is greater than 180° and less than or equal to 260°, a crossed absorption axes angle Ψ is 90° and above mentioned P1, P2 are within a range of ± 40° to ±50.

Furthermore, as noted in the Office Action, when a liquid crystal display of Amstutz is driven at 10 to 20V, which is included in a voltage range of Matsunaga, contrast and brightness becomes low as shown in Fig. 3 of Amstutz and in Fig. 3 of the present invention with broken line 21. In a liquid crystal display driving at 10 - 20V, contrast improves only in a mode with a crossed absorption axes angle Ψ being orthogonal and above mentioned P1, P2 being within a range of ± 40° to ±50.

By: **Yasushi KANEKO et al.** Serial No. **08/981,654**

CORRECT COPY OF CLAIM 1

1. A liquid crystal shutter comprising:

a liquid crystal device including a nematic liquid crystal sealed in between a first transparent substrate and a second transparent substrate on whose inner surfaces are formed respective transparent electrodes, said liquid crystal device having a twisted angle of greater than 180°and less than or equal to 260°; and

a pair of polarizing plates between which are sandwiched said first transparent substrate and said second transparent substrate, said polarizing plates having respective absorption axes which are orthogonal to each other, said absorption axes of said polarizing plates being angled within a range of ±40° to ±50° relative to a direction in which intermediate liquid crystal molecules are orientated, said direction indicating a direction of orientation of said liquid crystal in an intermediate portion in a direction of thickness of said liquid crystal device;

wherein said liquid crystal device is driven by applying DC or AC voltage of 10 to 20V, and birefringence of said liquid crystal device is nullified when said voltage is applied to said liquid crystal device.